CeraMem Corporation

Ceramic HEPA Filter

Technology Need:

Conventional disposable glass-fiber high-efficiency particulate air (HEPA) filters are used throughout the Department of Energy (DOE) complex in various systems. HEPA filters are critical elements for the prevention of the release of material to the atmosphere and thereby serve to protect workers, the public, and the environment.

However, these filters require routine removal, replacement, and disposal. This process is not only expensive, but also subjects personnel to radiation exposure and adds to an ever growing waste disposal problem. Conventional HEPA filters also create safety concerns in the areas of filter media strength, water damage, and operation in environments with elevated temperatures. There is a need for high quality, durable, moisture tolerant HEPA filters which can be regenerated or cleaned in situ as an alternative to conventional disposable HEPA filters.

Technology Description:

The CeraMem Corporation is developing ceramic monolith HEPA filters which can used to replace the conventional glass fiber filters. These filters have demonstrated the potential for long life and can be regenerated in situ. In addition to eliminating the costs associated with disposable filter replacement and disposal, the strong filter media will reduce the potential for a catastrophic HEPA filter failure due to high moisture content or fire.

The CeraMem filtration system removes submicron particles from a tank venting air stream. The air is drawn from the top of the tank, through one of the filter sets, by a vacuum pump. The dirty air with particulate matter enters the filter media, the entrained particles are

CeraMem Ceramic Filter after plugging with dust

then filtered from the air by a microporous membrane. The clean air then flows down clean channels and is exhausted from the filter.

While one of the filter sets is filtering the air stream, the other filter set is in a stand by mode. The filters become partially plugged by particles that they filter out. When the differential pressure across the filter reaches a specified level, the dirty filter is isolated and the stand by filter set is connected to the tank and the vacuum pump. Bench scale filters have been regenerated through a three step procedure:

1) Both the feed side and the downstream side of the filter are filled with nitric acid (10%). After a set time, the acid is drained into a holding tank.

2) The filter is filled completely with filtered water from the product (clean) side. The water is displaced with air into the waste storage tank. This step is repeated three times. The annular space between the filter and the housing is also flushed with water into the waste storage tank.

3) The filter is dried by flowing dry instrument air from the product side, through the filter, into the head space of the tank being vented. The acidic wastes are then neutralized with sodium hydroxide and pumped into the tank being vented.

Benefits:

▸Filters can be regenerated without being removed from the ventilation system

▸Eliminates personnel radiation exposure associated with removal of plugged filters

▸Eliminates high costs of filter replacement & disposal

▸Discharges from the system are compatible with the HLW tank contents (e.g., no organics or chlorides), therefore preventing generation of a waste stream that would require separate treatment

▸Filter systems are moisture tolerant both to minimize the possibility of soluble cesium releases and to meet the other performance requirements

▸Ceramic filters reduce the potential of a filter failure due to media breakthrough, moisture, or fire in the process ventilation system

Status and Accomplishments:

CeraMem developed prototype, regenerable, HEPA filter elements for performance testing at the Savannah River Technology Center (SRTC) in the HEPA Filter Test Assembly (HFTA). The filter elements were tested to determine the feasibility of regenerating or washing them in situ with a liquid after becoming plugged with simulated HLW sludge, simulated HLW salt, and atmospheric dust. They were tested in an environment in which they would plug rapidly, in order to maximize the number of filter cleaning cycles that would occur in a specified period of time.

The CeraMem filters passed the standard in-place Di-Octylphthalate (DOP) leak test of HEPA filters with an efficiency of 99.97% removal of 0.3 micron particles or better at the start, middle, and end of the test campaign. The filters were easily cleaned in situ and recovered to approximately the original differential pressure and airflow, even after numerous plugging/cleaning cycles.

Based on these positive results, CeraMem fabricated full-scale prototype filters for testing. Thirteen full-scale prototype filters underwent DOP testing by Air Techniques, Incorporated (ATI) at the Oak Ridge National Laboratory (ORNL). In general, 7 of 13 filters tested passed, all with retention well exceeding the HEPA DOP retention standard. Six failed, with consistent results. These were examined on return to CeraMem to identify and resolve any "consistent defect".

HLW personnel provided operational performance requirements to allow detailed design of regenerative HEPA filter systems for cold and hot demonstration and deployment at SRS. Prior to proceeding with detailed design, NETL determined that lack of near-term commitment for demonstration and deployment would jeopardize future success. Therefore, this project is currently undergoing closeout.

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For additional information, please visit the CeraMem Corporation's website at http://www.ceramem.com/